November 2009

The Region of the Forearm

nerve, owing to its close relation to the internal epicondyle and the difficulty of detaching the soft structures from that bony prominence. It is very important to preserve the periosteum over the olecranon and the strong fascia over the anconeus muscle, so that the triceps may not be altogether severed from the ulna. The relations of the parts exposed in the procedure by a posterior vertical incision (on the *left* side) are as follows (Plate 52, Fig. 6): the severed tendon of the triceps (No. 2) will be seen just above the trochlear surface of the lower end of the humerus (No. 3); upon the outer side of the olecranon process, which is denuded of its periosteum (No. 8), are the head of the radius (No. 4) and the radial recurrent artery (No. 5), while upon the inner side are the ulnar nerve (No. 7) and the posterior ulnar recurrent artery (No. 9).

As an illustration of the possible degree of injury which the elbow may recover from without loss of power or motion, the author may be justified in noticing in this connection a case recently under his care. The patient, a young man aged twenty-one years, received fractures of the internal epicondyle and the upper end of the ulna below the coronoid process in consequence of a fall upon the elbow while it was in a semi-flexed position. Seven weeks later, when he was regaining the use of the elbow, after constant passive motion, he met with another fall and fractured the olecranon of the same elbow through the greater sigmoid cavity. Owing probably to the passive use to which the triceps had been so recently subjected, and certainly to the extensive laceration of the ligaments and the periosteal connections, the process was drawn a hand's breadth away from its proper site. The local contusion and extravasation in both instances were unusually great, but, by careful perseverance, within two months complete use of the joint was obtained, both as to power and as to motion, and measurement proved that the olecranon was consolidated again with the ulnar shaft without any separation,—an unusual feature.

THE REGION OF THE FOREARM.

The shafts of the radius and the ulna, beyond their upper extremities, already described with the elbow, extend side by side to the wrist, and are peculiarly formed, not only to support the soft structures of the forearm.

but also to be adapted to their respective functions, the ulna being employed principally in extension and flexion, while the office of the radius is to rotate the hand in pronation and supination. The radius is external on the side of the thumb, the ulna is internal on the side of the little finger.

The *shaft of the radius* below the bicipital tubercle is prismatic in form, and gradually increases in breadth to the lower fourth of the bone, where it is expanded into a large quadrilateral-shaped extremity for articulation with the wrist. The radius is slightly bowed forward and inward, presenting an external border which is convex through its whole extent, and an internal or ulnar border which presents along its middle a sharp edge for the attachment of the interosseous ligament which connects the radius with the opposing sharp edge of the ulna. The *lower extremity of the radius* is the broadest part of the bone. It terminates in the *carpal articular surface*, which presents *two concave facets*, the outer of which is triangular, for the reception of the upper convex surface of the scaphoid bone, and the inner is quadrate, for the semilunar bone. The external border of the scaphoid facet is narrow, and prolonged downward in a conical projection, called the *styloid process of the radius.* The internal border of the semilunar facet is placed on a level considerably higher than the latter, and presents a depression for articulation with the contiguous convex border of the lower end of the ulna. The margins of the *ulnar depression* unite above and are continuous with the interosseous edge of the bone. The outer surface of the styloid process and the adjacent posterior surface of the lower end of the radius are grooved for the passage of the tendons of the extensor muscles (page 384). The articular surface of the lower end of the radius appears vertically concave, owing to the projection forward of the irregular sharp lip of bone, the *posterior crest*, which is the portion of the bone supposed to be detached from the shaft in the so-called Barton's fracture of the wrist.

The *shaft of the ulna* gradually diminishes in size from below the attachment of the brachialis anticus muscle to the lower end. It is prismatic in form, and is twisted in its axis, so that below the elbow it inclines a little toward the radius, becomes quite straight at its middle, and arches slightly away from the radius lower down, where its rounded articular

PLATE 50.

Figure 1.

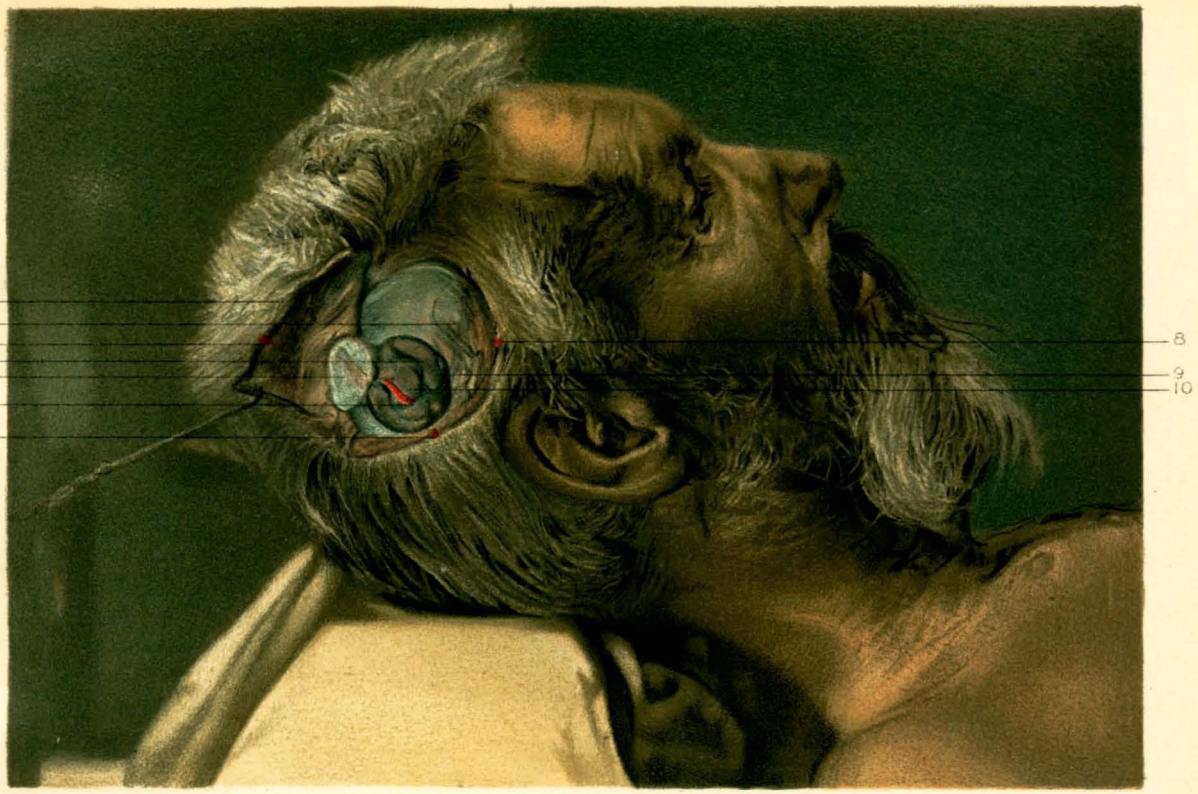
The relations of the structures involved in the operation of trephining the skull, as in a case of cortical epilepsy. The disk of bone has been removed and the pia mater partially detached to expose the convolutions on the right hemisphere, supposed to include the centre of the movements of the hand, and especially of the thumb.

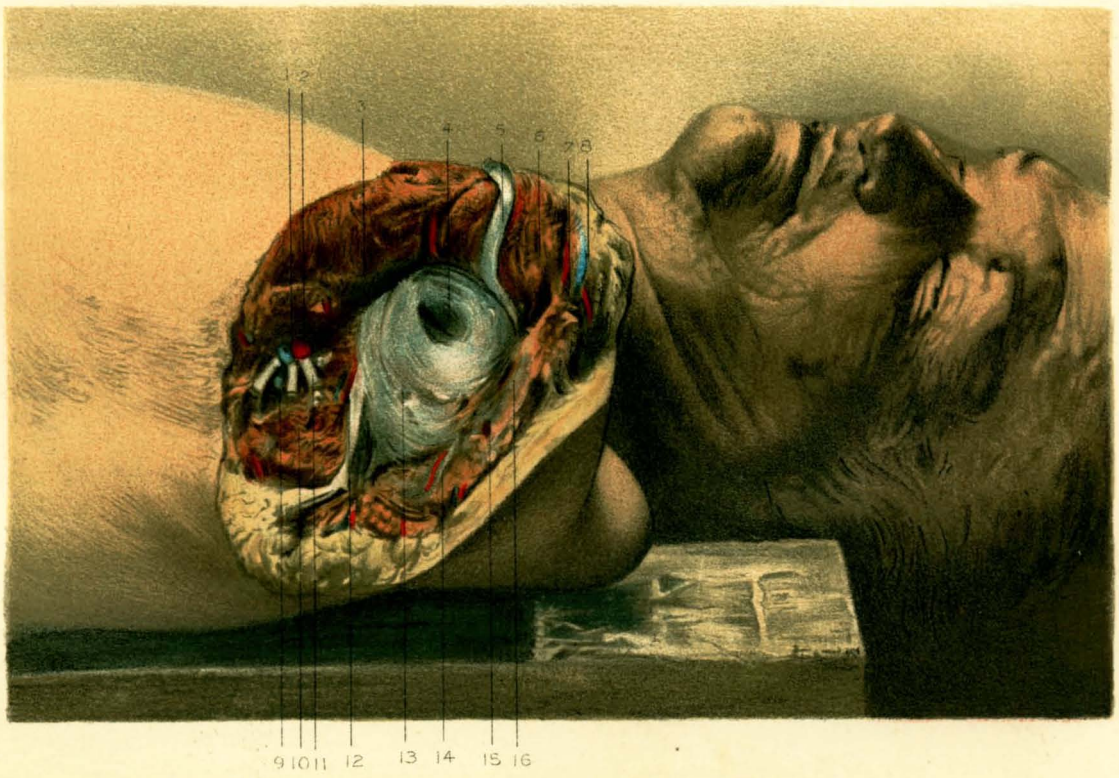
1. The scalp flap, including the periosteum, reflected from the bone.
2. The skull, with the temporal ridge plainly showing.
3. The upper cut end of the temporal artery.
4. The fissure of Rolando, in this case joining the horizontal branch of the fissure of Sylvius.
5. The flap of dura mater, with the cut branch of the middle meningeal artery seen through it.
6. A branch of the middle cerebral artery, lodged in the posterior part of the horizontal branch of the fissure of Sylvius.
7. A cut scalp artery, branch of the posterior temporal artery.
8. The lower cut end of the temporal artery.
9. The lower part of the anterior central, or ascending frontal, convolution.
10. The lower part of the posterior central, or ascending parietal, convolution.

Figure 2.

Amputation at the left shoulder-joint by the oval-flap method (of Larrey), showing the relations of the parts exactly as they appear after the completion of the operation. The anterior flap is formed by the pectoralis major, the heads of the biceps, the coraco-brachialis, the latissimus dorsi, the teres major, and the rotator muscles of the joint. The posterior flap is formed mainly by the deltoid muscle.

1. The axillary vein.
2. The axillary artery.
3. The cut pectoralis major muscle.
4. The glenoid cavity of the scapula, covered with its articular cartilage.
5. The glenoid, or long, head of the biceps muscle.
6. The clavicular portion of the deltoid muscle.
7. A branch of the anterior circumflex artery.
8. The cephalic vein and the descending branch of the acromio-thoracic artery.
9. One of the brachial veins.
10. The latissimus dorsi and teres major muscles.
11. The brachial plexus of nerves.
12. The inferior scapular artery and veins.
13. A portion of the capsular ligament.
14. The posterior circumflex vessels and nerve.
15. The cut deltoid muscle.
16. The position of the sub-deltoid bursa.





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surface bends back again to be received upon the depression on the inner border of the lower end of the radius. The internal border of the ulna is irregular, being rounded and smooth above and roughened below, while the external or radial border is provided with a sharp *edge*, except at the lower fourth of the bone. The lower extremity of the ulna is very small, and terminates in a hollow depression adapted to the triangular fibro-cartilage which intervenes between it and the wrist-joint. From the posterior border of the lower end, on the little-finger side, extends a small blunt-pointed bony projection, called the *styloid process of the ulna*. This is placed a little lower than the rounded bony prominence or *head* of the ulna, which is received against the depression on the radius, already mentioned, and forms the *inferior rádio-ulnar joint*. This joint is completed below by the upper surface of the triangular cartilage (page 397), and is surrounded with a *capsular ligament*, which is especially loose anteriorly. Some of the fibres of this capsule have been specialized, according to their relative positions, as the *anterior* and *posterior radio-ulnar ligaments*. They are continuous with the capsule of the wrist-joint proper. The opposing surfaces of the ulna and the triangular fibro-cartilage are not moulded to each other, and the intervals between them are filled by a loose fold of synovial membrane, called the *membrana sacciformis*. The shafts of the two bones of the forearm are connected by the oblique and interosseous ligaments. The *oblique ligament* extends from the lower surface of the tuberosity of the ulna downward and outward to the shaft of the radius below the bicipital tubercle. It is not always present, and is regarded as a specialization of the fascia covering the supinator brevis muscle, which arches over the insertion of the tendon of the biceps.

The *interosseous ligament*, or *interosseous membrane*, as it is sometimes called, consists of several layers of fibres, which pass chiefly obliquely from the sharp internal edge of the radius to the contiguous border of the ulna. This ligament is deficient above, to the extent of about two and a half centimetres, or an inch, below the tubercle of the radius, so that that process can have free play in the rotation of the bone on the ulna. In relation to the extensor muscles of the thumb there are additional fibres derived from their sheaths, which cross one another between the bones of the forearm.

The interosseous ligament, besides offering a broad surface for the attachment of the deep flexor and extensor muscles (page 383), strengthens the two bones and enables the hand to support a weight or to push against an object in extension, as when the ulna and the humerus are in a direct line, constituting the *humero-ulnar shaft.* The movements of *pronation* and *supination* take place between the bones of the forearm, about an axis which corresponds to a line drawn from the head of the radius through the lower end of the ulna and the metacarpal bone of the ring finger. Pronation is mainly limited by the lower two-thirds of the interosseous ligament, the inner part of the posterior carpal ligament, and the opposition of the bones. Supination is checked partially by the lowest part of the interosseous ligament and the internal lateral carpal ligament, and partially by the catching of the posterior edge of the ulnar depression of the radius upon the tendon of the extensor carpi ulnaris muscle, which passes over the groove on the back of the styloid process of the ulna. Owing to the loose capsular ligament about the inferior radio-ulnar joint, there is always a slight lateral motion between the bones at this articulation in the rotation of the radius. It should be remembered that the *interosseous space* is larger below than above, and that it is narrowest in complete pronation and widest in supination; and, further, that the bones of the forearm can be said to be parallel to each other only when they are held half-way between pronation and supination, or when the forearm is at right angles with the arm and the palm of the hand is turned upward. In the treatment of fractures of the forearm too great attention cannot be given to the proper adjustment of the bones so as to secure the preservation of the *interosseous space* from infringement, because such infringement is almost certain to be followed by a proportionate degree of loss of the rotating power of the wrist. In this connection it should be noted that the shafts of the radius and ulna vary in size relatively to each other according as they are considered near the elbow or near the wrist, the radius increasing and the ulna decreasing from above downward. This is well seen upon section of the bones, as in an amputation anywhere in this region (Plate 51, Fig. 3). Both bones are also nearer to the posterior than to the anterior surface of the forearm through their whole extent.

The internal and posterior surfaces of the ulna are wholly subcutaneous, and the lower part of the external surface of the shaft of the radius, as well as its head, can be readily felt through the skin,—the intervening portion of the radius being covered by the thick mass composed of the supinator longus and extensor carpi radialis muscles. The shape of the circumference of the upper portion of the forearm naturally depends upon the degree of muscular development, being generally oval in the male and round in the female and the child. In both of the latter the contour of the limb is influenced by the presence of a greater proportionate amount of fat upon the anterior and posterior surfaces. The variability in the transverse width in the upper part of the forearm is chiefly due to the degree of development of the muscles which take origin from the surfaces about the epicondyles of the humerus, the mass upon the radial side being the larger, already referred to as being more pronounced upon the posterior surface. On the lower third of the radial border the extensor muscles of the thumb produce a slight elevation as they pass obliquely downward (Plate 49). Above the middle of the forearm the muscles are always more developed anteriorly than they are posteriorly, while below it, where the muscles become tendinous, the two bones are more equally covered by the soft parts both anteriorly and posteriorly.

The *skin*, like that of the arm, is thinner, more sensitive, and more loosely attached by the superficial fascia to the deep fascia on the front and inner surface of the forearm than upon the back and outer surface. The superficial veins, lymphatic vessels, and cutaneous nerves are within the layers of fatty and connective tissue which compose the superficial fascia. The *veins* can usually be readily seen through the skin, passing upward from the wrist to the elbow. On the anterior surface the *superficial median vein* ascends along the front of the forearm, while upon the ulnar surface are usually a *small superficial anterior ulnar vein* and a *larger posterior ulnar vein.* The *superficial radial veins* commence at the radial dorsal plexus of the hand and ascend by several branches over the lower part of the posterior or dorsal surface of the forearm (Plate 47, Fig. 3), and then wind round the radial border to empty with the other superficial veins into the venous trunks at the front of the elbow, already described

(page 367). Besides these there are many superficial communicating veins which connect the median with the ulnar and radial veins at different points in the front of the forearm. It is noteworthy that the dorsal surface to the extent of ten centimetres, or four inches, below the olecranon process is comparatively free from superficial veins. It is also a fact often unheeded, that the greater part of the blood from this region is returned by the surface veins, so that any undue or improperly-applied pressure by splints or bandaging may result in œdema.

The *cutaneous nerves of the forearm* are derived from the branches of the musculo-cutaneous, the external cutaneous branch of the musculo-spiral, and the internal cutaneous nerves, which supply special areas and establish communications between their ultimate filaments. On the anterior surface below the elbow, the *anterior branch of the musculo-cutaneous* (page 357) supplies the radial border of the forearm as low down as the wrist (Plate 27, No. 56). About opposite the middle of the radius this nerve gives off the *posterior* branch, which winds backward to supply the skin on the dorsal surface as far as the wrist, where it joins with filaments from the radial and external cutaneous branches of the musculo-spiral nerve. A few of the lower filaments pass across the ball of the thumb and communicate with the palmar branch from the median nerve and the radial nerve in that locality. In relation to the elevation caused by the extensor muscles of the thumb the *radial nerve becomes superficial*, and curves over the radius to supply the back of the hand and the fingers (Plate 47, Fig. 1, No. 16, and Plate 53, Fig. 2). The *external cutaneous branches of the musculo-spiral nerve* (page 360) supply some filaments to the skin over the front of the forearm which join with fibres from the *anterior division of its inferior branch*, and some filaments to the outer and back part of the forearm, from the elbow to the wrist, by the *posterior division*. On the ulnar side the *anterior* branch of the internal cutaneous nerve (page 359) supplies the strip of skin over the ulna as far as the wrist. Below the inner side of the elbow the *posterior* branch passes backward to supply the upper portions of the posterior surface of the forearm. The *dorsal* branch of the ulnar nerve becomes subcutaneous close to the styloid process of the ulna (Plate 47, Fig. 3, No. 4), and dis-

tributes filaments over the back of the hand, which join with the terminal filaments of the external and internal cutaneous nerves about the wrist.

The *deep fascia of the forearm* is directly continuous with that of the arm, and forms a dense, close-fitting aponeurotic sleeve about the soft structures, being peculiarly modified above and below so as to contribute to the power of the muscles in their contraction and to restrain and preserve the position of the tendons. It is mainly composed of obliquely decussating fibres, which are reinforced in certain localities, as in front of the elbow, by fibres from the tendons of the biceps and brachialis anticus muscles, and at the wrist, where it forms the posterior annular ligament and contributes to the anterior annular ligament. The deep fascia is further attached to all the bony processes which are subcutaneous, especially to the epicondyles, the olecranon, and the inner border of the shaft of the ulna. The under surface of this fascia divides into septa, which not only separate the individual muscles from one another but also furnish to each of them additional surfaces for the origin of their fibres. It is perforated at intervals by the various cutaneous vessels and nerves.

The muscles of the forearm are disposed in two groups, an anterior group, consisting of the flexors and pronators, which are attached about the internal epicondyle of the humerus (page 348), and a posterior, consisting of the extensors and supinators, which are attached to the external epicondyle and the condyloid ridge above it. Each group further consists of two layers, superficial and deep. The *superficial layer of the anterior group* comprises five muscles, which are arranged in the following order from within outward: the pronator radii teres, the flexor carpi radialis, the palmaris longus, the flexor sublimis digitorum, and the flexor carpi ulnaris.

The *pronator radii teres* muscle arises by two distinct portions or heads, the most *superficial* being attached to the internal supra-condyloid ridge and to the adjacent intermuscular septum, and also, sometimes, to the supra-condyloid ligament (page 351), and the deeper portion by a thin tendon from the inner side of the coronoid process of the ulna. The fibres of these two portions unite and pass obliquely to be inserted by a

flat tendon into the oblique line and the pronator impression on the outer side of the radius. This muscle forms the inner border of the ante-cubital fossa at the elbow, and is supplied by twigs from the median nerve, which descend between its two portions (page 369). The special function of the pronator teres is to rotate the radius on the ulna, in conjunction with the pronator quadratus (page 384).

The *flexor carpi radialis muscle* arises from the common tendon about the internal epicondyle, from the intermuscular septa on each side of it, and from the overlying deep fascia. Its fibres pass obliquely outward and end in a long tendon, which is at first flat and becomes narrow toward the wrist, where, after crossing over the anterior annular ligament, it continues beneath the short flexor muscles of the thumb, through a fibrous arch in relation to the trapezium, and is inserted into the base of the metacarpal bone of the index finger. In the lower part of the forearm the tendon of this muscle is at the inner side of the radial artery and its veins, the tendon of the supinator longus being at the outer side (Plate 46, Fig. 1, No. 14). Between the tendon and the trapezium there is usually a bursa. There is sometimes an accessory muscle beneath the flexor carpi radialis, which arises from the radius and is inserted into the metacarpal bone of the middle finger, being also connected with the other muscle by a few fibres at its insertion. The function of the flexor carpi radialis is to flex the wrist and to abduct the hand, or, acting from below, it may assist in flexing the elbow. It is supplied by the median nerve.

The *palmaris longus muscle* is occasionally absent, and when present is always small. Its fibres unite into a slender flat tendon, which descends usually along the middle of the forearm upon the flexor sublimis muscle to the wrist, where, after passing over the annular ligament, it becomes continuous with the palmar fascia (Plate 48, Fig. 1, No. 8). In some instances the tendon of the palmaris longus is attached to the anterior annular ligament, without extending to the palmar fascia. Its muscular portion is subject also to great variety of development. The *flexor carpi ulnaris muscle* has a double origin, from the back of the internal epicondyle by a flat tendon, and by an expansion of the fascia over the olecranon, so that they form an arch under which pass the

ulnar nerve and ulnar recurrent artery. This muscle also takes origin from the fascia attached to the upper two-thirds of the ulna. The fibres from these sources present a penniform arrangement, as they enter a tendon on the radial side, which, after passing over the anterior annular ligament, is inserted into the pisiform bone, and to the fibrous expansion stretching across the unciform bone to the base of the metacarpal bone of the little finger. In the lower two-thirds of the forearm the ulnar artery, with its companion veins and the ulnar nerve, is placed between the tendons of the flexor carpi ulnaris and flexor sublimis muscles, the former muscle in reality overlapping the artery until within a short distance above the wrist (Plate 46, Fig. 1, No. 33). In relation to the annular ligament the ulnar vessels and nerve are protected by a fibrous expansion which extends between the ligament and the tendon of the flexor carpi ulnaris. This muscle receives twigs from the ulnar nerve as the nerve passes between its two portions above. Its function is to flex and adduct the wrist.

The *flexor sublimis digitorum muscle* is situated beneath the other muscles of the superficial layer, and arises by three separate portions, —one large, tendinous, and fleshy, from the internal epicondyle and the adjacent part of the capsular ligament of the elbow and from the intermuscular septa between it and the two carpal flexor muscles; one, small and tendinous, from the inner side of the coronoid process above the pronator teres; and another, thin, broad, and fleshy, from the oblique ridge on the front of the radius, extending from the bicipital tubercle to about two and a half centimetres, or one inch, below the insertion of the pronator teres, which partly overlaps it. The fibres from these different sources combine into one muscle, which passes down the middle of the forearm and subdivides into *four* distinct slips which terminate in four tendons arranged in two superposed pairs as they pass beneath the annular ligament into the palm. The superficial pair of tendons are continued to the middle and ring fingers, while the deeper pair go to the index and little fingers. All these tendons within the palm are placed beneath the branches of the median nerve and the ulnar artery (Plate 48, Fig. 3). Each of the tendons of the flexor sublimis muscle, as it enters the aponeurotic sheath which encloses it in relation to the meta-

PLATE 51.

Figure 1.

Amputation through the middle of the left arm by the antero-posterior oval-flap method, showing the proper relations of the vessels and nerves to the humerus, in a well-developed man, aged forty-eight years.

1. The anterior flap, composed chiefly of the biceps muscle.
2. The flap of the periosteum, which was dissected from the anterior surface of the humerus before the saw was applied to the bone.
3. The median nerve.
4. The ulnar nerve.
5. The posterior flap, composed chiefly of the triceps muscle.
6. Section of the left humerus, at its middle.
7. The medullary canal of the humerus.
8. The brachial artery and veins.
9. The superior profunda artery.
10. The musculo-spiral nerve.
11. The anastomotica magna artery.

Figure 2.

Amputation at the left elbow-joint by the antero-posterior flap method (of Dupuytren), showing the relations of the severed structures immediately after the completion of the operation. The olecranon process of the ulna is retained to preserve the function of extension of the triceps muscle.

1. The median nerve.
2. The brachial artery.
3. The brachial vein.
4. The ulnar artery and the ulnar nerve.
5. The anastomotica magna artery.
6. One of the recurrent branches of the ulnar artery.
7. The anterior flap, composed chiefly of the biceps and brachialis anticus muscles.
8. The musculo-spiral nerve.
9. The radial artery.
10. The lower end of the humerus, showing the trochlear surfaces of the condyles covered with articular cartilage.
11. The section through the greater sigmoid notch of the olecranon process of the ulna.
12. The posterior flap, composed of integument and the tendon of the triceps muscle.

Figure 3.

Amputation through the middle of the left forearm by the antero-posterior oval-flap method, showing the relations of the severed structures on completion of the operation.

1. The superficial median vein.
2. The anterior flap, composed chiefly of the flexor muscles.
3. The median nerve.
4. Section through the middle of the left ulna.
5. The ulnar artery and veins, and the ulnar nerve.
6. The radial artery and veins, and the radial nerve.
7. Section through the middle of the left radius.
8. The interosseous artery and the interosseous nerve.
9. The posterior flap, composed chiefly of the extensor muscles.
10. The superficial radial vein.

N. B.—These amputations were all done by means of a long, stout, straight bistoury, applied from without inward, which gives a *bevelled* appearance to the flaps, overcomes the retraction of the skin, and renders unnecessary the after-retrenching of the muscles. In each instance the vessels were left in the wound, as they would be before the application of the ligatures, and the nerves have been left as they were severed by the knife.

Fig 1

Fig 2

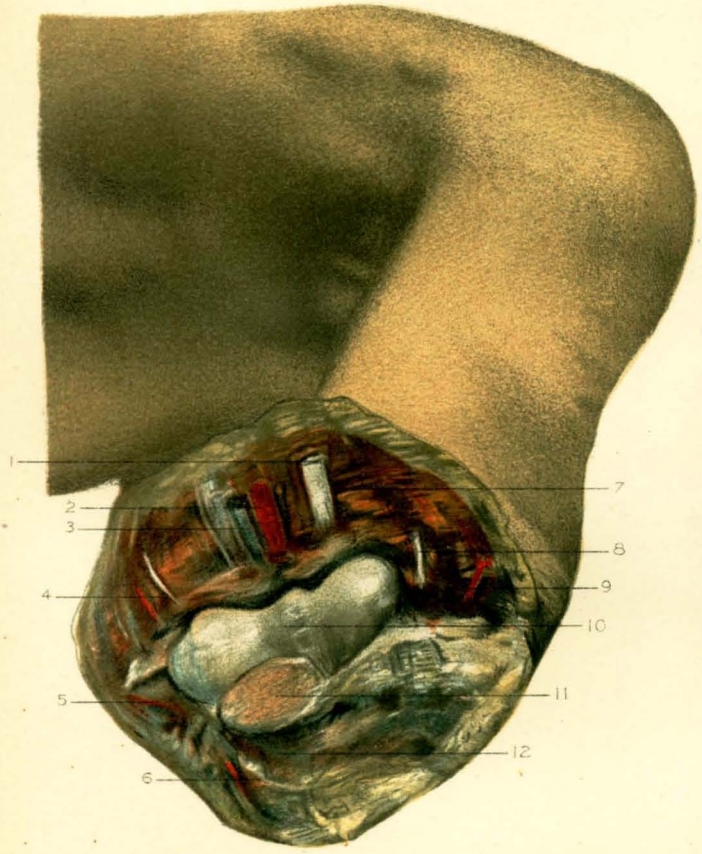
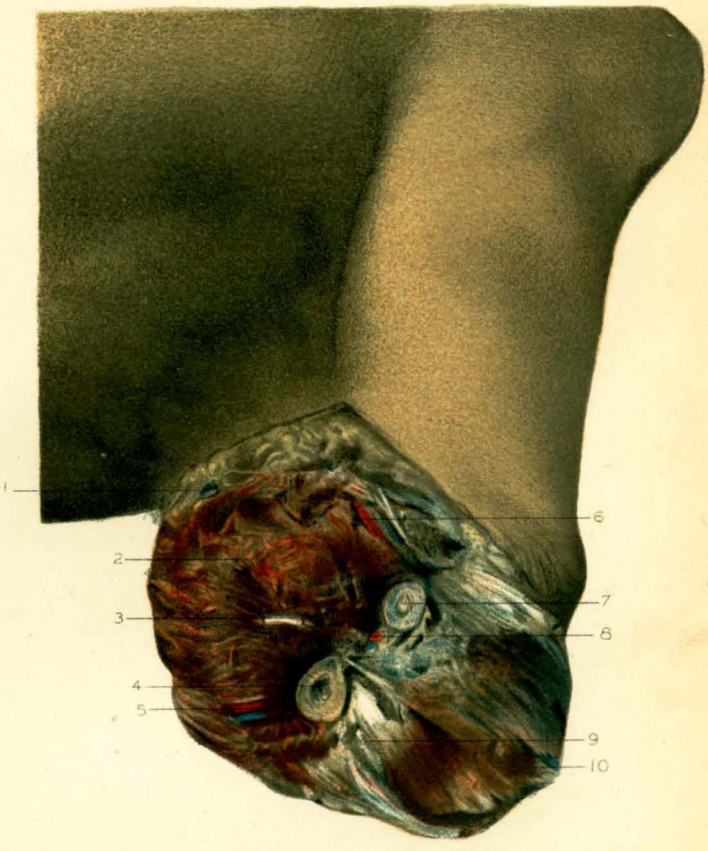


Fig 3



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carpo-phalangeal joint of its special finger, divides into two lateral slips, which diverge opposite the middle of the first or proximal phalanx so as to allow the corresponding tendon of the flexor profundus muscle to pass between them. The two lateral slips of the superficial tendon closely embrace the deep tendon, and pass behind it in such a way that their component fibres decussate before they separate again to be finally inserted into the sides of the second phalanges (page 404). The *action* of the flexor sublimis muscle is to flex the second joint of the fingers. The different portions of the above muscle are supplied by the median nerve.

The *muscles of the deep layer of the anterior group of the forearm* are the flexor profundus digitorum, the flexor longus pollicis, and the pronator quadratus. The *flexor profundus digitorum muscle* is the thickest individual muscular mass in this region. It arises from the inner two-thirds of the anterior surface of the ulna as far as the origin of the pronator quadratus muscle, and from the interosseous ligament in relation to the ulna. The fleshy mass resulting from the fibres thus arising soon divides into two portions, the outer one of which separates from the inner and main portion above the middle of the forearm and continues independently to its insertion into the index finger, while the fibres composing the inner portion are inserted into three flat tendons which pass side by side upon the same plane with their fellow-tendons to the index finger beneath the annular ligament, under the tendons of the flexor sublimis muscle. About the middle of the first or proximal phalanges of the fingers the deep tendons perforate the superficial tendons, to be inserted finally into the bases of the third or ungual phalanges (page 404). The tendons of the flexor profundus muscle serve to flex the finger-tips. Its nerves are branches of the interosseous branch of the median nerve and the ulnar nerve.

The *flexor longus pollicis muscle* arises mainly from the anterior part of the shaft of the radius, below the oblique line and above the pronator quadratus muscle, and from the adjacent part of the interosseous ligament. It sometimes also receives a few fibres of origin from the coronoid process. The fleshy fibres, becoming thicker toward the wrist, terminate in a tendon,

which passes under the annular ligament and between the two portions of the flexor brevis, to be inserted into the base of the last phalanx of the thumb. It strongly flexes the thumb, and receives its nerve from the interosseous branch of the median nerve.

The *pronator quadratus muscle* is a square muscle arising tendinously from the lower fourth of the oblique line on the ulna, and from the strong fascia covering its anterior surface. Its fibres pass transversely to their insertion into the lower fourth of the anterior surface and contiguous outer border of the radius. Its function is to pronate the radius in conjunction with the pronator teres muscle. The interosseous branch of the median nerve also supplies it.

The *muscles of the superficial layer of the posterior group of the forearm* are seven in number, and are arranged in the following order from the radial to the ulnar border: the supinator radii longus, the extensor carpi radialis longior, the extensor carpi radialis brevior, the extensor communis digitorum, the extensor minimi digiti, the extensor carpi ulnaris, and the anconeus. The *supinator radii longus muscle* arises by fleshy fibres from the external condyloid ridge of the humerus as high up as the musculo-spiral groove. It forms the outer boundary of the ante-cubital fossa of the elbow, and is the most external of the muscles covering the radial border of the forearm (Plate 49, Fig. 1, No. 2, and Fig. 2, No. 10). This muscle terminates about the middle of the forearm in a flat tendon which is inserted into the outer side of the base of the styloid process of the radius. At its insertion it is covered by the tendon of the extensor ossis metacarpi pollicis muscle (Plate 49, Fig. 2, No. 12). This muscle assists the anterior muscles in flexing the forearm, but it acts as a supinator upon the hand. It is supplied by a branch of the musculo-spiral nerve before its division.

The *extensor carpi radialis longior muscle* arises from the lower part of the external condyloid ridge and the septum intervening between it and the extensor brevior muscle. It soon ends in a flat tendon which is overlapped by the supinator longus, and, passing beneath the extensor muscles to the thumb, it traverses a groove on the outer and posterior surface of the lower end of the radius, to be inserted into the radial side of the

carpal end of the metacarpal bone of the index finger. The tendon of this muscle occupies the second groove in the posterior annular ligament. Its nerve is derived from the musculo-spiral nerve.

The *extensor carpi radialis brevior muscle* arises with the preceding muscle from about the external epicondyle, the intermuscular septa, and the adjacent part of the capsular ligament of the elbow. It is shorter and thicker than the extensor longior muscle, and its fibres terminate upon the under surface of a flat tendon below the middle of the forearm, where it is overlapped by the extensor longior. The tendon passes beneath the extensor muscles of the thumb, being accommodated in a special groove in the posterior surface of the lower end of the radius, and is inserted in the radial side of the base of the metacarpal bone of the middle finger. It is supplied by the posterior interosseous nerve. The tendons of both of the radial extensor muscles have usually small bursæ interposed between them and their insertions. They are peculiarly enclosed in a synovial sheath as they pass under the extensor muscles of the thumb, which allows them to play freely under these (page 388). Their function is to extend the wrist.

The *extensor communis digitorum muscle* arises from the lower part of the external epicondyle, the intermuscular septa, and the overlying expansion of the deep fascia. It divides on the back of the forearm into three portions, which terminate in tendons at different points and pass under the annular ligament posterior to the radius to the back of the hand, whence they are distributed to the fingers, the third tendon dividing so that it is distributed to both the ring and the little finger. Below the annular ligament the tendons become broad and flat and diverge from one another toward the knuckle-joints of the fingers, where they change in character, becoming thicker and narrower, and give off lateral expansions, which pass to the sides of these joints and thus form the *lateral metacarpo-phalangeal ligaments* (Plate 49, Fig. 2). On the back of the hand the two middle tendons generally pass over the corresponding metacarpal bones, while the tendon to the index finger passes obliquely across the space between the first and second metacarpal bones, and the tendon to the little finger, smaller than the other, continues in close relation to that of the ring finger until just above the metacarpo-phalangeal joint, where it diverges

abruptly to pass to its insertion. These tendons are often connected by accessory slips—*vincula*—above the knuckle-joints. They are subject to great variety, but they generally exist as strong slips extending from each side of the tendon of the ring finger to the adjacent tendon (Plate 49, Fig. 2, No. 8), so that this finger does not ordinarily admit of independent extension. The tendon of the index finger is usually free. On the back of each finger the common extensor tendon, after giving off the bands which serve as lateral ligaments to the metacarpo-phalangeal joint, is continued as the *digital aponeurosis*, into which the tendons of the corresponding lumbrical and interosseous muscles are inserted in relation to the second or medial phalanx (page 403), where the aponeurosis divides into three slips, the middle one of which is attached to the base of the medial phalanx, while the two lateral slips join in front of the latter and are inserted into the upper end of the third or ungual phalanx. This muscle is supplied by the posterior interosseous nerve. Not only is the function of this muscle to act as a general extensor of the fingers, but it can also act so as to extend the first phalanges while the second and third are flexed, and to extend the second and third phalanges while the first are flexed.

The *extensor minimi digiti muscle* arises from the external epicondyle and the adjacent intermuscular septa, and its fibres are arranged in a long slender bundle terminating in a tendon, which passes down the back of the forearm close to the tendons of the common extensor muscle, but occupying a separate compartment in the annular ligament, posterior to the inferior radio-ulnar joint. On the back of the hand the tendon divides into two slips which pass to the little finger, the slip on the radial side being joined by the tendon from the common extensor, already described, and then the tendons expand over the phalangeal joints and terminate in the same manner as the other extensor tendons of the fingers. It is supplied by the posterior interosseous nerve, and its special function is to extend the little finger independently.

The *extensor carpi ulnaris muscle* arises from the common tendon about the external epicondyle, from the septum between it and the preceding muscle, and from the posterior border of the ulna in immediate proximity to the origins of the flexor carpi ulnaris and flexor profundus digitorum

muscles. The fibres combine into a strong, broad tendon which is accommodated in a groove on the posterior surface of the ulna close to its styloid process, with which it is connected by a lateral expansion of fascia, and is finally inserted, after passing through a separate compartment in the posterior annular ligament, into the ulnar side of the base of the metacarpal bone of the little finger. There is also a fibrous expansion connecting its tendon with the extensor aponeurosis at the base of the little finger. The tendon is surrounded by an extension of the synovial membrane of the *wrist* as it lies in the groove on the ulna. When the forearm is in the position of full pronation, the end of the ulna can be *felt* and seen projecting between the tendons of the extensor carpi ulnaris and extensor minimi digiti muscles. There is usually a bursa placed beneath the tendon and the end of the bone. The posterior interosseous nerve supplies its proper nerve, and its function is to extend the hand toward the ulnar side.

The *anconeus muscle* is small, triangular, and placed at the external and posterior part of the elbow, arising by a tendon from the back of the external epicondyle and the contiguous portion of the capsule of the elbow-joint, from which diverging fibres pass to be inserted into the triangular surface on the upper fourth of the ulna. It is subcutaneous, and receives a special branch from the musculo-spiral nerve, which descends to it through the inner portion of the triceps muscle just above it. This muscle may be regarded as an extension of the triceps on to the forearm, which it assists in extending the elbow.

The *muscles of the deep layer of the posterior group of the forearm* are the supinator radii brevis, the three extensor muscles to the thumb, and the extensor indicis. The *supinator radii brevis muscle* arises beneath the mass of extensor muscles, from the lower and posterior part of the external epicondyle, from the external lateral ligament where it blends with the orbicular ligament, and from the roughened surface of the ulna below the lesser sigmoid cavity. The fibres of this muscle wind over the neck and upper part of the shaft of the radius and are inserted into the radius between the bicipital tubercle and the attachment of the pronator teres muscle. Occasionally there is a slip for this muscle attached specially

to the orbicular ligament. The supinator brevis is supplied by the posterior interosseous nerve (page 394), and acts as a powerful supinator of the radius.

The *extensor ossis metacarpi pollicis muscle* is situated immediately below the supinator brevis, and arises from the ulna below that muscle, from the interosseous ligament, and from the opposite surface of the radius. It descends obliquely, crossing over the radial carpal extensor muscles (Plate 49, Figs. 1, 2, and 3), about seven and a half centimetres, or three inches, above the wrist, passes through the annular ligament, and is inserted into the base of the metacarpal bone of the thumb, usually sending a slip to the trapezium. The *extensor primi internodii pollicis muscle* arises from the radius and the interosseous ligament just below the preceding muscle, which it accompanies through the annular ligament to be inserted into the base of the first phalanx of the thumb (Plate 49, Fig. 2, No. 14). This muscle is interesting as being peculiar to the human hand. The *extensor secundi internodii pollicis muscle* partially overlaps the preceding muscle, arising from the ulna below the extensor ossis metacarpi, from the interosseous ligament, and from the sheath of the *extensor minimi digiti muscle.* Its tendon passes independently through the annular ligament, in a distinct groove on the posterior surface of the radius, passes obliquely across the radial extensor tendons, and continues over the metacarpal bone and first phalanx of the thumb to be inserted into the base of the second or last phalanx (Plate 49, Fig. 1, No. 7). These tendons severally extend the portion of the thumb to which they are distributed. They can be readily distinguished through the skin, and the hollow produced by the extensor primi and extensor secundi tendons (the *tabatière anatomique*) is interesting because the radial artery here passes across its floor (Plate 49, Fig. 1, No. 17) to enter into the palm (page 414). The *extensor indicis muscle* arises from the posterior surface of the ulna, below the extensor secundi pollicis, and from the adjacent part of the interosseous ligament. Its tendon passes beneath the annular ligament in the same groove on the end of the radius with the tendon of the extensor communis muscle. It proceeds to the metacarpo-phalangeal joint of the index finger, where it is joined to the tendon from the common extensor (Plate 49, Fig. 1, No. 9).

This muscle is supplied by the posterior interosseous nerve, and its function is to enable the index finger to be extended independently.

The radial artery is the smaller of the two divisions of the brachial artery (page 354). It commences about opposite the head of the radius, and continues in the same line as the brachial artery as far as the wrist, being upon the radial side of the forearm, and for the most part between the supinator longus and flexor carpi radialis muscles. In the upper part of its course it is deeply situated between the pronator radii teres and the supinator longus, the fleshy border of the latter muscle usually overlapping it. This artery is superficial to the extent of eight centimetres, or a hand's breadth, above the wrist, and rests upon the lower part of the anterior surface of the shaft of the radius (Plate 46, Fig. 2, No. 16), so that it can be easily distinguished and compressed, and is therefore chiefly used as the most convenient vessel for examining the *arterial pulse.*

The *branches of the radial artery in the forearm* are the recurrent, superficialis volæ, muscular, and carpal. The *radial recurrent artery* is of variable size, arises below the elbow, and ascends between the supinator longus and brachialis anticus muscles, supplying in its course the two supinators and the two radial extensors (Plate 46, Fig. 1, No. 10). It inosculates with the superior profunda artery (page 354). The *arteria superficialis volæ* is variable both as to size and as to origin, and is sometimes absent. It usually arises from the radial artery near the wrist, where it turns to pass under the extensor muscles of the thumb. It runs over the anterior annular ligament (Plate 48, Fig. 2, No. 1) and above or through the muscles of the ball of the thumb, to anastomose generally with the superficial branch of the ulnar artery and establish the superficial palmar arch (Plate 48, Fig. 4, No. 4). There are nine or ten *muscular branches,* which furnish blood to the muscles on the radial border of the forearm. The *anterior* and *posterior carpal arteries* are small branches which usually leave the radial artery below the pronator quadratus and join the ramifications of the neighboring arteries in the *anterior* and *posterior rete carpi.*

The radial artery is accompanied by the *two deep radial veins,* or *venæ comites,* one on each side, which are connected by venous links extending

PLATE 52.

Figure 1.

The second phalangeal joint of the middle finger of the left hand laid open by an oval incision, as for the anterior flap of an amputation at this joint, to show the relations of the bone surfaces and the adjacent vessels.

1. The condyloid surface of the third or proximal phalanx of the middle finger.
2. The external lateral digital artery.
3. The glenoid surface of the head of the second phalanx of the middle finger.
4. The internal lateral digital artery.

Figure 2.

The metacarpo-phalangeal joint of the middle finger of the left hand opened, as in the first stage of an amputation (by the lateral-flap method) of the finger, to show the appearance of the ends of the bones at this joint. The position of the joint, on the dorsal surface, before the incisions were made, can be judged by comparison with the adjacent fingers.

1. The head of the metacarpal bone of the middle finger.
2. The external lateral digital artery.
3. The middle finger retained to show the character of the incisions for its removal by the lateral-flap method.
4. The trochlear surface of the third, or proximal, phalanx of the middle finger.
5. The internal lateral digital artery.

Figure 3.

Amputation at the carpo-metacarpal joint of the thumb of the left hand (by the flap method), showing the relative positions of the structures severed in the operation.

1. The radial artery where it passes into the palm.
2. The os trapezium.
3. The head of the metacarpal bone of the thumb drawn outward after division of the ligaments.
4. The thumb retained to show the proper character of the incisions in this amputation.
5. The external dorsal artery of the thumb.
6. The radialis indicis artery.
7. The princeps pollicis artery.
8. The internal dorsal artery of the thumb.

Figure 4.

The wrist-joint of the *right* hand laid open by an oval incision, as for the dorsal flap, in amputation at this joint, showing especially the appearance of the articulation between the lower end of the radius and the semilunar and scaphoid bones.

1. The lower end of the radius, showing the depression for the semilunar and scaphoid bones.
2. The triangular fibro-cartilage between the lower end of the ulna and the carpus.
3. The semilunar bone.
4. The cut tendons of the common extensor muscle to the fingers.
5. The divided radial artery.
6. The scaphoid bone.
7. The cut extensor tendons to the thumb.
8. The cut extensor tendon to the index finger.

Figure 5.

Vertical section through the articulations at the wrist of the *right* hand to show the synovial membranes and the cancellous structure and arrangement of the carpal bones.

1. The interosseous membrane.
2. Section through the lower end of the ulna.
3. The triangular inter-articular fibro-cartilage.
4. Section through the proximal row of the carpal bones.
5. Section through the distal row of the carpal bones.
6. Section through the heads of the metacarpal bones.
7. Section through the cuneiform bone.
8. Section through the pisiform bone.
9. Section through the unciform bone.
10. Section through the lower end of the radius.
11. Section through the semilunar bone.
12. Section through the scaphoid bone.
13. Section through the os magnum.
14. Section through the os trapezium.
15. Section through the trapezoid bone.
16. Section through the heads of the metacarpal bones.

Figure 6.

The left elbow-joint laid open posteriorly, as in the process of resection or excision of this articulation, to show the relations of the opposing bones and the adjacent structures.

1. The lower posterior portion of the left arm.
2. The severed tendon of the triceps muscle.
3. The trochlear surface of the lower end of the humerus.
4. The head of the radius.
5. Branch of the recurrent radial artery.
6. The upper portion of the left forearm.
7. The ulnar nerve.
8. The olecranon process of the ulna.
9. Branch of the recurrent ulnar artery.

Fig 1

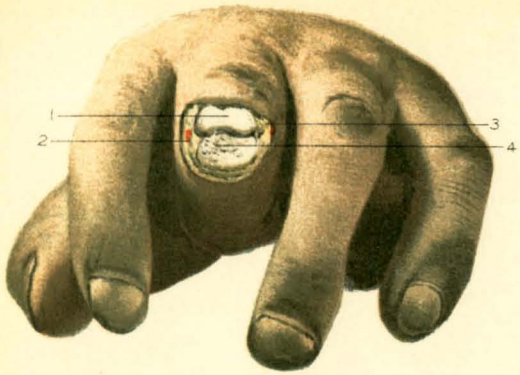


Fig 2

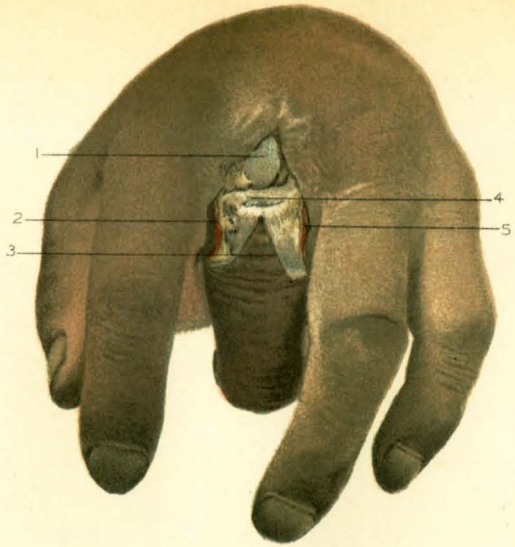


Fig 3

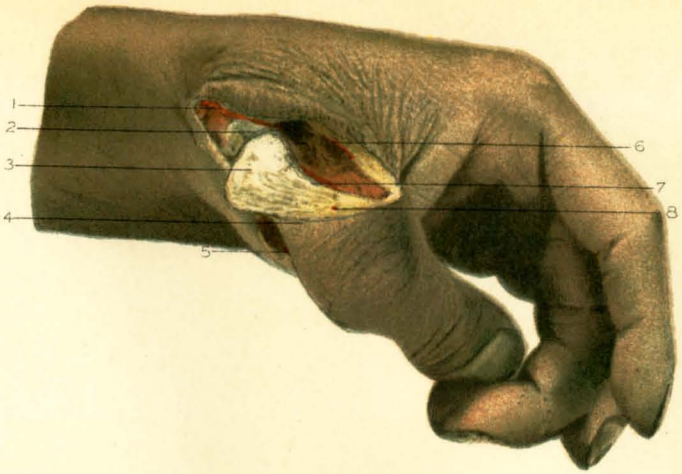


Fig 4

Fig 5

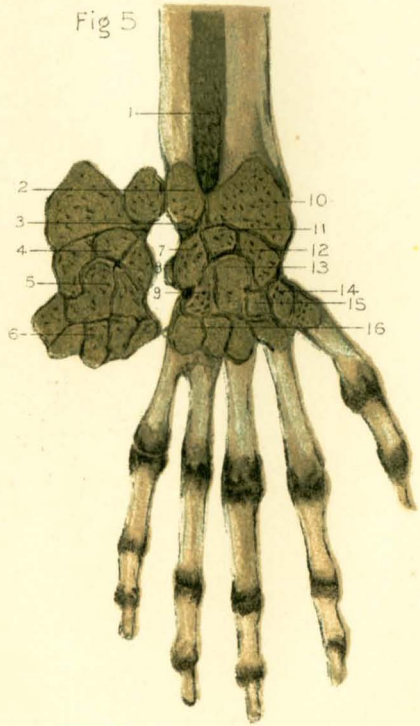
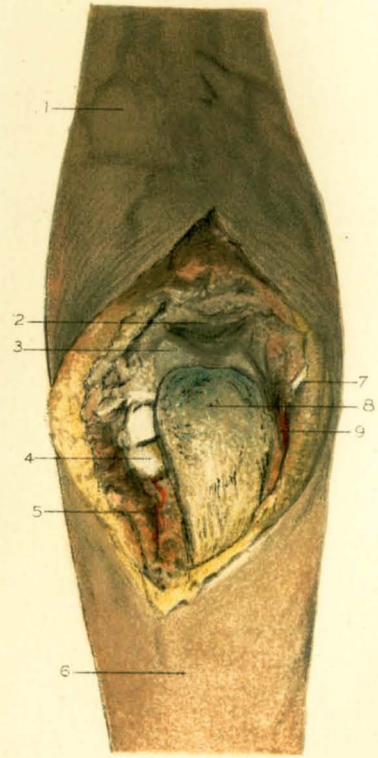


Fig 6



Dissected, Photographed and Colored from Nature by George Mc. Clellan, M.D.

Armstrong & Co. Lith. Boston.

across the artery at frequent intervals, and join the venæ comites of the brachial artery in the ante-cubital fossa. The *radial nerve*, which is a branch of the musculo-spiral nerve (page 360), is in relation to the outer side of the radial artery in the middle third of the forearm only. About six centimetres, or two and a half inches, above the wrist the radial nerve passes under the tendon of the supinator longus muscle, to be distributed to the back of the hand (Plate 47, Fig. 1, No. 16).

Above the wrist, in the pulse-area, the radial vessels are often tortuous (Plate 46, Figs. 1 and 2). The *line of reference for the radial artery* may be drawn from the middle of the bend of the elbow to the ulnar side of the styloid process of the radius, or, for all practical purposes, an incision made parallel to the radial border of the forearm and two centimetres, or a finger's breadth, from it will expose the sheath of the radial vessels.

The ulnar artery is larger than the radial, with which it commences opposite the head of the radius at the bifurcation of the brachial artery. In the first part of its course it *curves* deeply beneath the pronator teres, the superficial flexor muscles, and the median nerve to the space between the flexor sublimis digitorum and flexor carpi ulnaris muscles, being overlapped by the tendon of the latter, and so completely ensheathed by a reflection of the deep fascia that its pulsation above the wrist can rarely be felt during life. Its course along the lower half of the forearm is more superficial and direct (Plate 46, Fig. 2).

The *branches of the ulnar artery in the forearm* are the anterior and posterior ulnar recurrent, articular, common interosseous, muscular, and carpal. The *anterior* and *posterior ulnar recurrent arteries* arise generally by a common trunk just after the origin of the main vessel at the elbow. The anterior passes upward to anastomose with the anastomotica magna and inferior profunda arteries. The posterior is the larger, and ascends between the two heads of the flexor carpi ulnaris muscle to the space between the olecranon and the internal epicondyle, by the side of the ulnar nerve, to communicate with the inferior profunda, anastomotica magna, and other arteries in the rete olecrani (page 370). The *articular branch* pierces the anterior part of the capsule of the elbow-joint at the

outer border of the brachialis anticus muscle. The *common interosseous artery*, which is four centimetres, or about one and a half inches, in length, arises from the ulnar artery, below the bicipital tubercle of the radius, and divides at the opening between the oblique and interosseous ligaments (page 375) into anterior and posterior branches. The *anterior interosseous artery* passes downward, being held in close contact with the interosseous ligament by a sheath of areolar tissue, as far as the upper border of the pronator quadratus muscle, where it subdivides into anterior and posterior branches, which join respectively the anterior and posterior *carpal rete*. The anterior interosseous artery in its course gives off the nutrient arteries to the radius and ulna, supplies the adjacent muscles with blood, and sends some perforating twigs through the interosseous membrane to the deep extensor muscles. It is provided with two *venæ comites* (Plate 46, Fig. 2, No. 14), and accompanied by a branch of the median nerve, the *interosseous nerve*, which overlies it superficially. The *posterior interosseous artery*, after reaching the posterior surface of the interosseous ligament, is in close relation with the posterior interosseous nerve (page 394). It gives off, besides muscular twigs to the superficial and deep extensor muscles, a *recurrent branch*, which joins the rete olecrani above, and finally ends below in the posterior carpal rete. The *muscular branches* of the ulnar artery are about a dozen in number, distributed to the contiguous muscles upon the ulnar side of the forearm. The anterior and posterior carpal branches arise from the ulnar artery above the wrist and join with the corresponding branches from the radial artery in forming the posterior carpal rete and the posterior palmar arch. The ulnar artery is also closely ensheathed with its two *venæ comites*, which are connected at intervals by venous links and empty into the venæ comites of the brachial artery below the elbow. The *ulnar nerve* takes a direct course along the ulnar side of the forearm, from the internal epicondyle to the radial side of the styloid process of the ulna, and therefore is at a considerable distance from the upper part of the ulnar artery, but for about six centimetres, or two and a half inches, above the wrist it is in close relation to the sheath of the vessels, the nerve being always to the ulnar side. Both vessels and nerve pass over the anterior an-

nular ligament together (Plate 48), and are held closely to the pisiform bone by an expansion of the fascia from the tendons of the flexor carpi ulnaris muscle. The *lines of reference for the ulnar artery* may be drawn from the tendon of the biceps at the front of the elbow to the middle of the ulnar side of the forearm, and thence straight to the radial side of the pisiform bone. Below the middle of the forearm the artery may be exposed by an incision made parallel to the ulnar border two centimetres, or a finger's breadth, from it. It should not be forgotten that the ulnar artery above the wrist is closely embraced by the border of the flexor carpi ulnaris muscle, and that therefore it is not so accessible or easy of exposure for a ligature as is the radial.

The *median nerve in the forearm* descends, after passing between the two heads of the pronator radii teres muscle below the flexure of the elbow (page 369), along the middle of the forearm, between the flexor sublimis and flexor profundus digitorum muscles. It is quite deep at first, but gradually becomes more superficial where the flexor muscles become tendinous, and at the wrist it passes beneath the anterior annular ligament between the outer tendon of the flexor sublimis and the inner border of the flexor carpi radialis muscle (Plate 46, Fig. 1, No. 16, and Plate 48, Fig. 3, No. 2). Near the elbow the median nerve sends, besides the two branches to the two heads of the pronator teres muscle, *muscular branches* to all the flexor muscles except the flexor carpi ulnaris and the ulnar part of the flexor profundus. The *anterior interosseous nerve* leaves the median just below the pronator teres muscle, and accompanies the anterior interosseous vessels (page 392), being on their radial side. It supplies the flexor longus pollicis, part of the flexor profundus, and the pronator quadratus muscles. There is also a *cutaneous palmar branch*, arising five centimetres, or two inches, above the wrist, which passes over the annular ligament and supplies the skin of the palm. Very often there is a branch from the median which joins the ulnar nerve where it is in more particular relation to the ulnar artery. The *ulnar nerve in the forearm*, as already stated (page 392), passes in a direct line from the front of the internal epicondyle to the radial side of the pisiform bone. At the elbow it gives off an *articular* branch to the elbow-joint, and soon after branches to both

of the heads of the flexor carpi ulnaris and the contiguous part of the flexor profundus muscle. About the lower third of the forearm the ulnar nerve distributes two branches, called from their distribution the *anterior* and *posterior ulnar cutaneous branches.* The *anterior* passes superficially over the ulnar artery to supply the skin of the front of the wrist, and the *posterior* passes beneath the tendon of the flexor carpi ulnaris to the *dorsal* surface. A few twigs from the ulnar nerve also supply the wrist-joint.

The *branches of the musculo-spiral nerve in the forearm*, besides the twigs supplied to the supinator longus and extensor carpi radialis longus muscles (page 360), which leave the nerve in the space between the brachialis anticus and the supinator longus in the outer depression of the elbow, are the posterior interosseous and the radial. The *posterior interosseous nerve* is the larger of the two terminal branches. It turns backward through the supinator brevis and passes downward between the superficial and deep extensor muscles to the middle of the posterior part of the forearm, curving thence under the extensor secundi internodii pollicis muscle to the back of the wrist. It supplies all the extensor muscles with which it is in relation throughout its course, and may be regarded exclusively as a motor nerve. The *radial nerve* is the cutaneous branch of the musculo-spiral in the forearm. Its course is along the middle of the forearm, under cover of the supinator longus muscle and to the outer side of the radial vessels. Above, in relation to the elbow, the nerve is placed considerably to the outer side of the artery; below, it passes beneath the tendon of the supinator longus muscle (Plate 47, Fig. 3, No. 8), pierces the deep fascia, and subdivides into two terminal branches, which are distributed to the skin on the back of the radial border of the hand (page 408), some of the filaments communicating with the terminal filaments of the musculo-cutaneous nerve.

Although *fractures of the bones of the forearm* are very common, it is surprising how little attention has been given to the anatomy of the parts involved, a knowledge of which would certainly influence the method of their treatment. These injuries may affect both the radius and the ulna, or either of these bones. When the two bones are broken, the violence

may be direct or indirect. When the radius is broken alone, it is generally due to indirect violence transmitted from the hand. When the ulna is broken alone, it is usually owing to direct violence and to its exposed position. Whatever shortening or displacement may occur in any form of these injuries is not so much in consequence of muscular action upon the fragments as on account of the direction from which the violence is received. The essential feature of the treatment of fractures of the forearm is the preservation of the normal dimension of the interosseous space, as already stated (page 376). This is generally appreciated nowadays; but it is of equal importance to remember that in all fractures, in whatever region they occur, the bones are not the only tissues which suffer from the injury. There is always accompanying the breach in the continuity of the bones more or less damage to the soft structures about them. The interosseous ligament and periosteum, with their special vessels, must be lacerated, and although in one sense this is essential for the process of repair, yet it presents a factor which probably accounts for the frequent unsatisfactory results of treatment. It should be borne in mind that the radius supports the hand, and that therefore it is most liable to suffer from non-union. The superficial veins (page 408) play a valuable part in nature's efforts at repair, and should not be interfered with. As soon as bony union has been obtained, passive motion should be resorted to at regular intervals.

The fracture at the lower end of the radius, known as *Colles's fracture*, usually occurs transversely from half an inch to one and a half inches above the wrist-joint. This is probably due to the character of the internal structure of the bone in this situation. The expanded lower end of the radius is mostly cancellous, while the shaft which joins it possesses a greater amount of compact tissue (Plate 52, Fig. 5). This fracture is usually caused by the weight being transmitted through the hand outstretched in the position of pronation to break the shock in the act of falling. The degree of displacement depends measurably upon whether the ligaments of the inferior radio-ulnar joint are ruptured.

The *development of the radius* occurs from three centres. The head is ossified in the fifth year, and joins the shaft about the eighteenth year.

The lower extremity is ossified during the second year, but does not unite with the shaft before the twentieth year. The *development of the ulna* also is from three centres, one for the shaft and one for each end. At birth the extremities are entirely cartilaginous. The olecranon does not begin to ossify until the tenth year, and it is joined to the shaft about the sixteenth year. The lower extremity ossifies in the fourth year, and joins the shaft in the twentieth year. It should be noted that the epiphyses which meet at the elbow unite with their shafts earlier than those at the opposite ends of the bones, also that the foramina of the medullary arteries are directed toward the elbow.

In *amputation through the middle of the forearm* by the antero-posterior oval-flap method, the parts exposed in the flaps when made upon the *left* side bear the following relations (Plate 51, Fig. 3). The anterior flap is composed chiefly of the flexor muscles, in the margin of which in the superficial fascia is the cut superficial median vein (No. 1). The median nerve (No. 3) is in the middle of the flap, between the severed superficial and deep flexor muscles. The ulnar vessels and the ulnar nerve (No. 5) are close to the sawn end of the ulna, and the radial vessel and the radial nerve are close to the sawn end of the radius. The interosseous vessels and nerve are between the bones. The posterior flap is composed chiefly of the extensor muscles, and in its margin will be found the superficial radial vein (No. 10).

THE REGION OF THE WRIST AND THE HAND.

The skeleton of the hand consists of the *carpus*, or wrist, which connects the hand with the forearm, the *metacarpus*, or median portion of the hand, and the *phalanges*, or digital extremities. The *carpal bones* are eight in number, polygonal in shape, and are composed of cancellous tissue enclosed in a compact layer. They are arranged in two rows, each of which contains four bones, counting from the external or radial side, as follows: in the upper or *proximal* row, the scaphoid, semilunar, cuneiform, and pisiform; in the lower or *distal* row, the trapezium, trapezoid, magnum, and unciform. Each of these little bones presents a dorsal surface which is usually comparatively smoother and larger than the